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ABSTRACT

A study investigated the effects of microcomputers on children's attention to reading tasks and the relationship between previous reading achievement and grade level on such attentional behavior. Fifty-five third and fifth graders read two stories each, one presented on a microcomputer and one presented in print. Television cartoons and rock music were presented as a distraction during the readings. Videotapes of the subjects were used to determine each subject's frequency of instances off task (FOT), cumulative time off task (TOT), and total completion time (TCT). The results indicated subjects took longer to complete the story presented on the microcomputer than one presented in text, although more subjects preferred the microcomputer presentation to the text presentation. Fifth graders were off task fewer times than third graders and completed the task faster than the third graders. In addition, significant differences were found between good, average, and poor reading achievement groups for FOT, TCT, and comprehension scores. (HTH)

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The Effects of Microcomputers on Children's Attention to Reading Tasks

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Abstract

The purpose of this study was to investigate the effects of microcomputers on children's attention to reading tasks and the relationship between previous reading achievement and grade level on such attentional behavior. Third and fifth graders read two stories each, one presented on a microcomputer and one presented on text. While they were reading, a television presented cartoons and rock and roll music as a distraction. The subjects were videotaped by a hidden camera. The videotapes were used to determine each subject's frequency of instances off task (FOT), cumulative time off task (TOT), and total completion time (TCT). The results indicated that subjects took longer to complete the story presented on the microcomputer than that presented on text. Second, fifth graders were off task fewer times than third graders and completed the task faster than the third graders. Third, significant differences were found between good, average, and poor reading achievement groups for FOT, TCT, and comprehension scores. Fourth, significantly more subjects preferred the microcomputer presentation to the text presentation. This study represents an attempt to directly assess the effects of computers on attention and to reach a better understanding of how children interact with computers in school situations. In addition, the multidimensional profile of attention used in this investigation may prove to be useful in other systematic studies of attention in educational settings.

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THE EFFECTS OF MICROCOMPUTERS ON CHILDREN'S ATTENTION TO READING TASKS

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Objectives

The purpose of this study was to investigate the effects of microcomputers on children's attention to reading tasks. Five concerns were addressed: a) the differences in attentional performance between microcomputer and textual presentation of material, b) developmental differences in attentional behavior, c) the effects of previous reading achievement on attentional behavior, d) children's presentation mode preference, and e) the reliability of the methodology for identifying different aspects of attention in school situations.

Theoretical Background

With the increasing use of microcomputers in classrooms, claims are being made that children are more motivated by and pay more attention to instructional tasks when they are presented on microcomputers as opposed to traditional texts (Bright, 1983; Roberts, 1983; Ruply & Chevrette, 1983; White, 1983a, 1983b). These claims, however, rely for the most part on anecdotal evidence. In fact, many researchers operate on precisely the opposite assumption, that is, that microcomputers do not affect

attention (Cirilo & Foss 1980; Kosminsky, 1977, for example). They depend on microcomputers for the controlled presentation of text in experiments on reading comprehension and text processing, apparently assuming that there are no differences between reading text on a microcomputer or in print. Questioning the use of microcomputers in reading experiments, Belmore (in press) found that college students took longer to read and comprehended less of microcomputer-presented passages than paper-presented passages. However, these effects were only present when the subjects read the computer-presented passages first. The unfamiliarity of both the computer presentation and the reading task created enough difficulty to interfere with the processing needed to complete the task.

The lack of controlled study of the effects of microcomputers on attentional behavior may be due to the difficulty of defining and measuring attention. The most common method of measuring student involvement in school tasks, usually labeled "time-on-task", is to rate each student's behavior as "on" of "off" task at predetermined intervals. The percentage of on-task behaviors is calculated (engagement rate) or multiplied by the total allocated time (engagement time) (Caldwell, Huitt, & Graeber, 1982). In the reviews of the literature time-on-task has been found to be significantly related to

task achievement at elementary, secondary, and adult levels in reading, language arts, mathematics and other subject areas (Frederick & Walberg, 1980; Caldwell et al, 1982; Bloom, 1974).

Time-on-task studies have been criticized for the extreme variability in their results and the lack of data on internal consistency, bringing into question the reliability of the measure itself (Hudgens, 1967; Karweit & Slavin, 1981, 1982; Peterson & Swing, 1982). Although time-on-task research has contributed a great deal to the understanding of children's classroom behavior, the methodology does not provide a sensitive measure of the complex nature of attention.

Anderson and his colleagues (Anderson, Alwitt, Lorch, & Levin, 1979; Anderson & Lorch, 1983) have devised a more comprehensive measure of attention in their studies of television viewing. They recorded the duration of each look at and away from the screen, as well as the frequency of looks away from the screen, yielding a profile of each subject's attention. In the present study, this profile-of-attention methodology was used to assess the effects of presentation mode (computer vs. text), age, and reading ability on attention to and comprehension of simple reading tasks.

Methods

Third and fifth graders (N=55) read two stories each, one presented on a microcomputer and one presented on text. While they were reading, a television presented cartoons and rock and roll music as a distraction. The subjects were videotaped by a hidden camera. In addition, comprehension scores, story ratings, and reading achievement test scores were collected for each subject. Following the experiment each subject was interviewed about the experiment. The videotapes were used to determine each subject's frequency of instances off task (FOT), cumulative time off task (TOT), and total completion time (TCT).

Results

Multivariate Analysis

The major analysis was a 3 (Reading Achievement) x 2 (grade) x 2 (mode of presentation) repeated measures MANOVA with four dependent variables: comprehension, Frequency Off Task (FOT), Time Off Task (TOT), and Total Completion Time (TCT). Significant multivariate main effects were found for reading achievement ($F(8,92) = 30.62$, $p < .0001$), grade ($F(4,47) = 24.29$, $p < .0001$), and mode of presentation ($F(4,47) = 10.43$, $p < .0001$). Table 1 presents a summary of the multivariate and univariate analyses.

Univariate Analyses

Mode of Presentation. Results of the univariate F tests as presented in Table 1 indicate that Total Completion Time (TCT) was the only dependent variable affected by mode of presentation ($F(1,50) = 11.03, p < .001$). An examination of the TCT means in Table 2 shows that the subjects took .63 minutes longer to read the computer version than the text version ($t(50) = 2.01$, $p < .05$) ($\bar{X} = 4.39$ and 3.76, respectively).

Insert Table 2 About Here

Interaction. None of the univariate interaction effects were significant. This means that there is an achievement by grade interaction effect on the four dependent variables when they are considered simultaneously, as a set. However, when each dependent variable is considered separately, the effect is not great enough to reach significance.

Previous reading achievement. Comprehension, Total Completion Time (TCT), and Frequency Off Task(FOT) were affected by previous reading achievement. Comprehension had the highest univariate F ($F (2,50) = 19.95$, $p < .0001$). A

Bonferroni post-hoc test indicated that all three of the achievement levels were significantly different (t (50) = 2.48, $p < .05$). As Table 3 indicates, the mean comprehension score for the good readers (12.50) was almost two points higher than that of the average readers (10.88), whose mean score was almost three points higher than that of the poor readers (8.06).

Insert Table 3 About Here

TCT had the second largest univariate F (F (2, 50) = 9.82, $p < .001$). The post-hoc test found that all achievement levels were significantly different (t (50) = 1.78, $p < .05$). The good readers ($\bar{X}$ = 2.94) completed the story a minute faster than the average readers ($\bar{X}$ = 4.08), who completed the story a minute faster than the poor readers ($\bar{X}$ = 5.30). (See Table 2).

Significant differences were also found for FOT (F (2,50) = 5.10, $p < .01$). The post-hoc test found no difference between good and average readers. Table 4 presents the means for FOT. Poor readers ($\bar{X}$ = 6.83) were off task significantly more times than both good ($\bar{X}$ = 2.23) and average ($\bar{X}$ = 3.95) readers (t (50) = 2.48, $p < .05$).

Insert Table 4 About Here

Grade. Total Completion Time (TCT) and Frequency Off Task (FOT) were both affected by grade differences. Fifth graders took over a full minute less to complete the task than third graders ($\bar{X}$ = 3.31 and 4.81, respectively; F (1,50) = 10.63, $p < .01$). (See Table 2). Fifth graders were also off task an average of three times less than third graders (X = 2.43 and 5.86, respectively; F (1,50) = 6.88, p <.09). (See Table 4).

Chi-Square tests

A one sample Chi-Square Goodness of Fit Test indicated that significantly more subjects preferred the microcomputer presentation to the text presentation (n = 48 and 7, respectively, χ^2 (1) = 39.79, $p<.001$). Chi-Square tests were also used to test for independence between mode preference, grade, achievement and gender. No significant relationships were found.

Correlations

Partial correlations indicated that Frequency Off Task (FOT), Time Off Task (TOT), and Total Completion Time (TCT)

were positively correlated. Comprehension was negatively correlated with FOT and TOT. Finally, interrater correlations were extremely high for FOT, TOT, and TCT (r=+.95, +.997, and +.96, respectivley), indicating the reliability of the measures.

Discussion

The most striking finding was that despite the fact that the children overwhelmingly preferred the computer presentation, they did not perform better. That is, they were not on task any more often, they did not stay on task any longer, and they did not comprehend any better when reading from the computer. In fact, the only significant difference between the two modes favored the text presentation - it took more time to read the stories on the microcomputer.

Since there were no differences in the amount of time spent off task or the instances off task, it is apparent that the students actually spent more time on task. One explanation is that, because of the general unfamiliarity of the computer and the task, the process of turning the pages (pressing an arrow) took longer. When viewing the videotapes, the researchers noticed that the students often looked away from the story while turning the pages of the text, but not when "turning the pages" of the microcomputer.

Turning pages is a familiar and automatic process that does not usually require attention. Hence, it affords the opprotunity to monitor the environment, in this case, the cartoons. The page turning process for the microcomputer is not that familiar, so the subjects had to interrupt their reading to look at the cartoons. In addition, the unfamiliarity of the microcomputer task may have contributed to a slower reading rate.

Even though microcomputers have have become commonplace in the business world, they still retain a special status in our schools. Working with a computer is a rare event for most children. It will be years before microcomputers become part of the workaday school routine, and we can obtain a more genuine appraisal of this technology. In the meantime, the novelty of the microcomputer can be a double-edged sword. The excitement of doing something new or different can certainly be a motivational factor. However, as this study demonstrates, this novelty may also affect the student's ability to complete the task. When adequate time is provided for the task to be completed, the benefits of positive attitudes towards the task should be considered.

Since this study represents an initial attempt to directly assess the effects of computers on attention, we must be careful in applying its findings to education. However, the method used to measure attention is very

promising. Since it involves timing easily observed behaviors from a videotape, the reliabilities of each component measure are very high. In addition, the multidimensional profile of attention which is obtained for each individual affords a detailed picture of attention during task performance. Therefore, this methodology should prove extremely useful to those interested in the systematic study of attention in educational settings.

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Table 1

Summary of Multivariate Analysis of Variance

Source of Variation	Tests of Significance: Multivariate F	df	Univariate F: Comprehension	Total Completion Time	Time Off Task	Frequency Off Task
Achievement	30.62****	2	19.95****	9.82****	2.82*	5.10***
Grade	24.29****	1	2.56	10.63***	2.93*	6.88**
Mode	10.43****	1	1.09	11.03***	.62	.28
Achievement X Grade	5.98****	2	1.43	1.17	.46	1.13
Achievement X Mode	.88	2	.05	.52	.45	.04
Grade X Mode	.43	1	.20	.59	.30	2.28
Achievement X Grade X Mode	.54	2	.21	.03	.06	.65

*p .10
**p .05
***p .01
****p .001

N=55

Table 2

Means and Standard Deviations of Subjects' Total Completion Times* Across Grades, Achievement and Modes

Achievement	Grade					
Mode	Third		Fifth		Total	
	M	SD	M	SD	M	SD
Good Readers						
Computer	3.38	.65	2.96	.48	3.19	.59
Text	2.77	1.06	2.60	.69	2.69	.88
Total	3.08	.90	2.78	.60	2.94	.77
Average Readers						
Computer	5.66	2.42	3.52	.56	4.45	1.94
Text	4.73	2.16	2.93	.71	3.72	1.74
Total	5.20	2.29	3.23	.70	4.08	1.86
Poor Readers						
Computer	5.89	1.83	4.92	1.50	5.57	1.73
Text	5.53	1.61	4.04	.42	5.03	1.50
Total	5.71	1.68	4.48	1.12	5.30	1.60
Total						
Computer	5.15	2.16	3.60	.93	4.39	1.83
Text	4.47	2.03	3.02	.79	3.76	1.70
Total	4.81	2.10	3.31	.90	4.08	1.79

*Total completion time is presented in minutes

Table 3

Means and Standard Deviations of Subjects' Comprehension Scores Across Grades, Achievement and Modes

Achievement	Grade					
Mode	Third		Fifth		Total	
	M	SD	M	SD	M	SD
Good Readers						
Computer	11.71	1.38	13.17	.98	12.38	1.39
Text	12.00	1.73	13.33	.52	12.62	1.44
Total	11.86	1.51	13.25	.75	12.50	1.39
Average Readers						
Computer	10.16	2.09	11.44	1.65	10.78	1.97
Text	10.63	1.95	11.33	2.66	10.97	2.32
Total	10.39	2.01	11.39	2.18	10.88	2.14
Poor Readers						
Computer	7.60	2.80	7.83	3.37	7.96	2.91
Text	8.40	2.88	8.50	2.17	8.44	2.56
Total	8.00	2.79	8.17	2.72	8.06	2.72
Total						
Computer	9.75	2.60	11.07	2.62	10.35	2.67
Text	10.28	2.50	11.17	2.73	10.68	2.63
Total	10.01	2.55	11.12	2.66	10.52	2.64

Table 4

Means and Standard Deviations of Subjects' Frequency Off Task Across Grades, Achievement and Modes

Achievement	Grade					
Mode	Third		Fifth		Total	
	M	SD	M	SD	M	SD
Good Readers						
Computer	3.43	3.41	1.00	1.55	2.31	2.90
Text	2.86	3.53	1.33	1.63	2.15	2.82
Total	3.14	3.35	1.67	1.53	2.23	2.80
Average Readers						
Computer	7.77	7.64	1.59	1.87	4.27	5.98
Text	6.23	6.21	1.65	1.84	3.63	4.81
Total	7.00	6.86	1.62	1.82	3.95	5.39
Poor Readers						
Computer	6.25	7.44	6.50	7.23	6.33	7.04
Text	6.50	5.98	9.00	6.38	7.33	5.94
Total	6.38	6.52	7.75	6.45	6.83	6.39
Total						
Computer	6.25	6.78	2.18	3.48	4.25	5.78
Text	5.46	5.61	2.67	3.81	4.09	4.98
Total	5.86	6.18	2.43	3.62	4.17	5.35